
Appendix C

RICHARD BRIGHT'S ANALYSIS

BEVERLY HILLS SUPPER CLUB FIRE

SOUTHGATE, KENTUCKY

MAY 28, 1977

AN ANALYSIS OF THE DEVELOPMENT AND SPREAD
OF FIRE FROM THE ROOM OF FIRE ORIGIN (ZEBRA
ROOM) TO THE CABARET ROOM

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Prepared By: R. G. Bright, Senior Research Engineer, Center
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INTRODUCTION

Around 8:45 p.m. in the evening of May 28, 1977, a fire occurred in the Beverly Hills Supper Club located in Southgate, Kentucky. In addition to the total destruction of the Club, the fire resulted in the death of 164 persons (as of July 10, 1977). Based on on-site investigations and analyses of taped interviews with employees of the Club, it has been established⁽¹⁾ that the fire originated in a small, L-shaped, public room known as the Zebra Room. This room was located against the front (south)⁽²⁾ wall, to the east of the main entrance.

Most of the victims of the fire were occupants of the Cabaret Room, which was located at the opposite end of the building from the Zebra Room, some 150 feet or so distant and on the same side (east) of the Club. An interior corridor, running most of the length of the Club in the east half, was a conduit in funneling the smoke, heat and fire from the Zebra Room to the Cabaret Room. Based on newspaper accounts, the Club contained somewhere in excess of 3,000 persons. Nearly all of the occupants of the spaces and rooms between the Zebra Room and the Cabaret Room were able to exit the building safely.

(1) See statement by the Kentucky State Fire Marshal on page 4.

(2) Although the Club did not have a true north-south, east-west orientation, such an orientation has been assumed for ease of description. See Figure No. 1 for this assumed orientation.

The purpose of this report is to provide the most likely explanation of the role of the corridor on the rapidity of spread of smoke, gases heat and flames from the Zebra Room to the Cabaret Room. What follows is based on an on-site investigation by the writer, laboratory analysis of key materials, and utilization of available scientific, fire research information.

CONSTRUCTION DETAILS PERTINENT TO THIS ANALYSIS

The pertinent construction details of the Zebra Room are described later on in this analysis under "ORIGIN AND CAUSE OF FIRE" and therefore will not be described here. The Zebra Room had two sets of double doors of wood construction, both swinging into the room. (See figure no. 1.) One set was to the west, opening into the reservationist's alcove. This west opening allowed the fire to pass into the main bar area but at some later stage in the fire sequence as these doors were in the closed position in the early stages of the fire according to the reservationist. The other doorway, to the north, opened into a small, east-west corridor, approximately 32 feet long and 20 feet wide. This small corridor opened into the main bar on the west and into the main, north-south corridor (to the Cabaret Room) on the east through a fifteen-foot wide opening. A curved, steel stairway to the second floor was located in this small corridor, just to the left (west) of the Zebra Room's north doors and against the north wall of the Zebra Room.

The ceiling of this small corridor was of concealed, kerf and spline, mineral-type, acoustical tile. Due to its mineral nature, this tile is likely to have had a very low flame spread index⁽³⁾ and can be considered to be noncombustible. The walls of this small corridor were covered with a decoratively-finished, plywood paneling, somewhere between 3/16-inch and 1/4-inch in thickness, applied over wood furring strips⁽⁴⁾. This plywood was combustible and, although samples were not available to establish a flame spread index it was probably between 100 and 200 based on ASTM E-84

(3) For explanation of flame spread index see the Handbook of Fire Protection, 14th Edition, page 6-46, published by the National Fire Protection Association, 1976.

(4) The small pieces of paneling remaining in this corridor were swollen and/or delaminated making accurate measurements difficult.

testing procedures⁽⁵⁻⁶⁾ and our knowledge of the behavior of these materials.

The floor of the small corridor was covered by a carpet installed over an underlayment (padding). The carpet was the same as used in the Zebra Room, according to the Kentucky State Crime Laboratory. Analysis of the Zebra Room carpet by the National Bureau of Standards (NBS) (Appendix A) indicates it was a nylon carpet with a low pile height (0.375 inches) and dense construction (58 oz/yd²). The padding has not been identified but probably was of heavy, commercial grade, as this was characteristic of underlayments recovered from other portions of the Club.

The main, north-south corridor, leading north from the 15-foot wide opening within the east portion of the Club to the Cabaret Room, was approximately 8-feet wide and about 150-feet long. (See figure 1.) In addition to serving doorways to the Viennese Room on the east and the Empire Room on the west, this corridor connected to two cross corridors, one to the east along the south wall of the Cabaret Room, and one to the west between the Garden Room and the employees crossover, service corridor. This main corridor terminated outside of the principal entrance to the Cabaret Room. The cross corridor, along the south wall of the Cabaret Room, is important because of its effects on the exit of the occupants from the Cabaret Room, as will be discussed later in this analysis.

The main corridor's ceiling was of concealed, kerf and spline, mineral-type, acoustical tile, again, essentially noncombustible in nature. The floor was covered with a carpet applied over an underlayment. Based on NBS analysis (Appendix A), the carpet was essentially of woven, wool construction with a small amount (less than 10%) of acrylic fibers blended in. The pile height was 0.25 inches and weight was 78 oz/yd². The underlayment was identified by NBS to be jute with a pad height of 0.5 inches and a weight of 51 oz/yd².

(5) Standard Method of Test for Surface Burning Characteristics of Building Materials, ASTM E-84-70, American Society for Testing and Materials.

(6) See the Underwriters Laboratories Building Materials Directory, January 1976, page 204, for representative flame spread indices of similar materials.

The corridor walls were covered with a decoratively-finished, hardboard paneling applied over wood furring strips. This paneling was combustible and, although its flame spread index could not be determined, our experience indicates that it probably ranged somewhere between 150 and 200⁽⁷⁾. This paneling was applied to both walls of the corridor for its full length except for the curvilinear wall, at the west cross corridor, which was of exposed brick.

ORIGIN AND CAUSE OF THE FIRE

On June 10, 1977, a statement was presented to the press by Mr. Warren Southworth, State Fire Marshal of Kentucky. This statement contained information as to origin and cause of the fire. This information was based on reports and data collected by the fire investigation team. The statement read as follows:

"Based on the investigation to date, including both interview evidence and evaluation and examination of physical evidence, the investigative team has concluded that the fire originated in a concealed space within the Zebra Room.

"The most probable cause of ignition within this area was electrical in nature and would have been fed by combustibles located there. Specifically, the presence of concealed, combustible ceiling tile and wood materials used for supports provided a fuel supply for continued spread of the fire through the original and other concealed spaces. On-site analysis of the construction of the concealed spaces within the Zebra Room indicates that the fire burned for a considerable time prior to discovery. Interviews with occupants of the Zebra Room and adjacent areas support this conclusion.

"The above-mentioned ignition sequence led to an intense heat buildup within the concealed space which ultimately resulted in the accumulation of smoke and hot gases within the Zebra Room itself. It was at this point when the fire was discovered, and attempts were made to extinguish it. Some time thereafter, various actions were initiated to notify occupants of the building and the fire department.

(7) See the Underwriters Laboratories, Inc., Building Materials Directory, January 1976, page 174, for representative flame spread indices of similar materials.

"During the time attempts were being made to extinguish the fire within the Zebra Room, flash-over occurred. In other words, simultaneous ignition of all combustible materials within the room occurred.

"Following the occurrence of flash-over, the fire continued to build until it broke out of the Zebra Room through double doors located at the north end of the room. The fire then spread rapidly throughout the structure."

When flash-over occurred in the Zebra Room, the room resembled a furnace in that all of the combustible furnishings in the room were burning simultaneously. These furnishings included several wood tables, about 20 or more chairs (see Appendix C for details on the chairs), and the carpet. Under these circumstances the walls of the rooms, which were covered with 3/16-inch, combustible hardboard paneling applied over wood furring strips, would also have been burning and contributing to the fire. What follows is a most probable scenario for the action of the fire.

This furnace-like fire had only one immediate flue or vent available to it and this was the pair of doors at the north end of the room. From eye-witness accounts, apparently one door, the west leaf, was partially open, perhaps at 45 degrees or so (confirmed by on-site evidence). It was likely the other leaf was open also, and the physical evidence suggested that it may have been fully open. Regardless of whether this leaf was open, partially open, or closed, this would have been of significance only through the first minutes of the fire as the fire's intensity was of such magnitude that the fire would have quickly consumed the top part of this wooden door.

The venting of the fire through this doorway resulted in the passage of smoke, flames and heat through the upper part of the doorway at relatively high velocities, with an inrush of cold, fresh air, at lower velocities, near the floor. As the smoke, flames and hot gases left the Zebra Room they were propelled across the ceiling of the small corridor directly outside the Zebra Room until they hit the far wall, some 20 feet distant. Here, the flames and hot gases split, with part of flames and hot gases turning down and part turning sideways in both direction. The thin, plywood paneling, on the far wall of the small corridor, would have ignited readily under the impact of this flame and hot gas exposure.

In the meantime, the fire on the carpet in the Zebra Room would have spread through the doorway also, slower than the flames and hot gases along the ceiling, but sustained by the thermal radiation down onto the carpet by the smoke and hot gas layer at the ceiling. In examination of the Zebra Room, it was found that the carpet and its padding were completely consumed, down to bare concrete, in the doorway opening, the only location in the Zebra Room with such extensive damage.

The flames and hot gases leaving the Zebra Room, in addition to impinging on the plywood paneling of the small corridor wall, also were probably passing up the stairway to the west of the lobby, into the main bar to the west, and through the 15-foot opening into the main corridor to the east.

It was apparent, from the on-site investigation, that sufficient heat was present in the stream of hot gases passing through this 15-foot opening into the main corridor to ignite combustibles present in this corridor. These combustibles consisted of the hardboard paneling on the walls and the carpet system on the floor.

As the flames and hot gases entered the main corridor, the carpet and the hardboard paneling began to contribute combustible gases to the fire through the driving off of the combustible volatiles in the carpet and the paneling. This resulted in the extension of the burning down the corridor. At about this period in time, sufficient thermal radiation was being directed down on the carpet surface from the smoke and hot gas layer at the ceiling to cause the spread of the fire on the carpet from the small corridor through the 15-foot doorway, into the main corridor. Once this happened, the fire in the corridor was very nearly a self-sustaining fire, feeding on both the carpet and the paneling, with each contributing to the growth and spread of the other. Even so, energy was still being supplied into the main corridor from the fire in the Zebra Room and the small corridor outside. From this point, fire spread rapidly down the main corridor, with visible fire rolling along underneath the ceiling and a secondary fire traveling along on the carpet face, trailing behind the ceiling fire.

EFFECTS OF THE MAIN CORRIDOR FIRE ON THE CROSS CORRIDOR AND CABARET ROOM EXITS

When the main corridor fire reached the first cross corridor, the corridor behind the south wall of the Cabaret Room, the fire extended down this cross corridor as well as down the

main corridor. If this scenario is correct then this had an unfortunate consequence for those occupants still in the Cabaret Room as one of the secondary exits for the Cabaret Room was across this corridor to a door leading to the outside of the building. (See figure 1.) In other words, as fire came down this cross corridor, it cut-off this exit from usage by the Cabaret Room occupants. At the same time, the fire in the main corridor was in the process of closing off the main entrance door to the Cabaret Room. So, in effect, the main corridor fire blocked two of the three exits available to the Cabaret Room occupants leaving them with only the exit in the northeast corner of the room which passed through the service bar area. Shortly after the fire in the main and cross corridor rendered these exits unsafe for use, the fire began to penetrate the Cabaret Room through these very same exit doors.

EFFECTS OF SMOKE

The effects of smoke on the Club's occupants has been deliberately omitted from the above analysis. Based on our experience with corridor fires, the smoke from the original fire in the Zebra Room and from the fire in the corridors would have spread in the same direction as the fire, but at an earlier period in this sequence. In other words, the smoke would have reached the Cabaret Room some time ahead of the fire. This smoke would have appeared to be dark, almost black in nature, to the occupants. In addition, it would have been extremely irritating, causing tearing of the eyes and a burning sensation to the nose. This was due to the nature of the materials undergoing combustion, i.e., the carpets and wall paneling. In addition, for a fire of this type, the smoke would have contained certain toxic gas species, the principal one being carbon monoxide. Carbon monoxide, although colorless and odorless in the quantities likely to have been present in the early stages of this fire, produces confusion and disorientation. Later, of course, as the levels increased, carbon monoxide produced unconsciousness and ultimately death among some of the occupants.

EFFECTS OF AIR CONDITIONING

The public spaces of the Supper Club were completely air conditioned and it was in operation at the time of the fire. There was no central system but rather a series of separate systems serving various areas. It is not clear whether the air conditioning systems had any adverse effects, such as

spreading or retarding the movement of smoke or of the fire, at least during the early stages of the fire. What is clear, however, is that once the fire left the Zebra Room, the fire was probably of sufficient energy to overpower the air handling system. It was suggested, in some newspaper accounts, that the air conditioning system helped spread the smoke and the fire. This hypothesis may or may not be true but the smoke and the fire would have had no difficulty spreading throughout the Club and through the public use spaces, such as the corridors, as there were no barriers to the movement of smoke and fire through these spaces and the fire had sufficient thermal energy to move the smoke through these spaces.

RAPIDITY OF SPREAD OF FIRE IN THE MAIN CORRIDOR

The rapidity of the spread of fire from the Zebra Room to the Cabaret Room, via the main corridor, undoubtedly was a factor in the large loss of life in the Cabaret Room. While it is not possible to give more than an educated estimate, from the experience of this writer, it is postulated that once the fire had emerged from the Zebra Room and crossed over into the main corridor, the fire probably reached the Cabaret Room in somewhere between two and five minutes. Some of the Viennese Room patrons were ushered out of the Viennese Room by employees, across the main corridor, through the Empire Room, through the kitchen and out. One of the members of this party has reported that he looked back as they were crossing the Empire Room and could see fire in the main corridor. These patrons were probably ushered out of the Viennese Room some two to three minutes after flash-over had occurred in the Zebra Room.

Research activities here at NBS on full-scale corridor fire experiments have indicated that the rapid spread of fires may be possible in corridors when the only combustible present in the corridor are some types of carpet/underlayment combinations(8-10). If there is a movement of air in the

- (8) Fung, F., Et al, The NBS Program on Corridor Fires, Fire Journal, Vol. 67, No. 3, pp 41-48, May 1973.
- (9) Quintere, J.G., A Characterization and Analysis of NBS Corridor Fire Experiments in Order to Evaluate the Behavior and Performance of Floor Covering Materials, Nat. Bur. of Stds., NBSIR 75-691, June 1975.
- (10) Alderson, S., Et al, Evaluation of the Fire Performance of Carpet Underlayments, Nat. Bur. of Stds., NBSIR 76-1018, Sept. 1976.

corridor in the direction of the fire spread, this air movement may increase the rapidity of fire spread, once the fire has entered the corridor.

Research conducted at IIT Research Institute⁽¹¹⁾ has shown that a fire can spread down a corridor when the corridor has noncombustible floors and ceilings but the walls are covered with continuous, floor-to-ceiling, combustible paneling with flame spread indices in excess of 59. The main corridor in the Beverly Hills Supper Club not only had a combustible carpet assembly on the floor but also had wall linings with a flame spread index of somewhere between 100 and 200. There was probably some air movement in the corridor, but the precise nature, quantity, speed, and direction are unknown.

Our experience with simulated corridor fire tests would indicate that this configuration of materials and geometry will produce a rapid spread of fire down a corridor such as this one.

EFFECT OF NONCOMBUSTIBLE-SURFACED WALLS ON THE SPREAD OF FIRE IN THE MAIN CORRIDOR

The carpet/underlayment system used in the main corridor of the Club was subjected to the NBS-developed flooring radiant panel. (See Appendix B.) This panel, which is described elsewhere⁽¹²⁾, essentially measures the amount of thermal radiant energy necessary to cause a fire to spread on a flooring system. Many carpets, and the one used in the main corridor is an example, will not propagate fire from a simple ignition source, such as a dropped cigarette or match. However, if the carpet is preheated at an increasing rate, such as by a thermal radiation from a smoke and hot gas layer at the ceiling, a point is reached where the heating and generation of hot gases is sufficient for the ignition of the carpet from a small, external flame. If the heating continues, the fire will spread along the carpet indefinitely, as long as the thermal radiation from the ceiling hot gas layer continues. The flooring radiant panel permits a determination to be made as to how much thermal energy is necessary to promote fire spread along the carpet face. The results are given in terms of critical radiant flux.

(11) Waterman, T. E., Corridor Flame Spread, Fire Journal, Vol. 67, No. 6, pp 66-72, Nov. 1973.

(12) Benjamin, I.A., Et al, The Flooring Radiant Panel Test and Proposed Criteria, Fire Journal, Vol. 70, No. 2, pp 63-70, March 1976.

As stated above, the carpet/underlayment assembly from the main corridor was tested by NBS in the flooring radiant panel. The critical radiant flux was found to be an average of 0.78 watts per square centimeter. What this means is that the carpet assembly had relatively good resistance to the propagation of flame under thermal radiation exposure as compared to other commercially-available carpets. (The higher the number, the better.) Table I gives results of several carpet assemblies (with underlayment) tested in NBS' flooring radiant panel. As can be seen from this comparison, the main corridor carpet assembly was better than any of these in terms of resistance to propagation of flame under thermal radiation exposure. However, if the thermal radiation exceeds the critical radiant flux, then a fire can be expected to spread along the carpet face.

TABLE 1

Flooring Radiant Panel Results - Carpet with Underlayment
(Typical Values)

<u>Type of Material</u>	<u>Critical Radiant Flux</u>
*Wool and Hair Jute	0.66
*Acrylic and Hair Jute	0.25
*Nylon A and Hair Jute	< 0.10
*Nylon B and Hair Jute	0.35
*Polyester A and Hair Jute	< 0.10
*Polyester B and Hair Jute	< 0.10
Beverly Hills-Wool and Jute	0.78

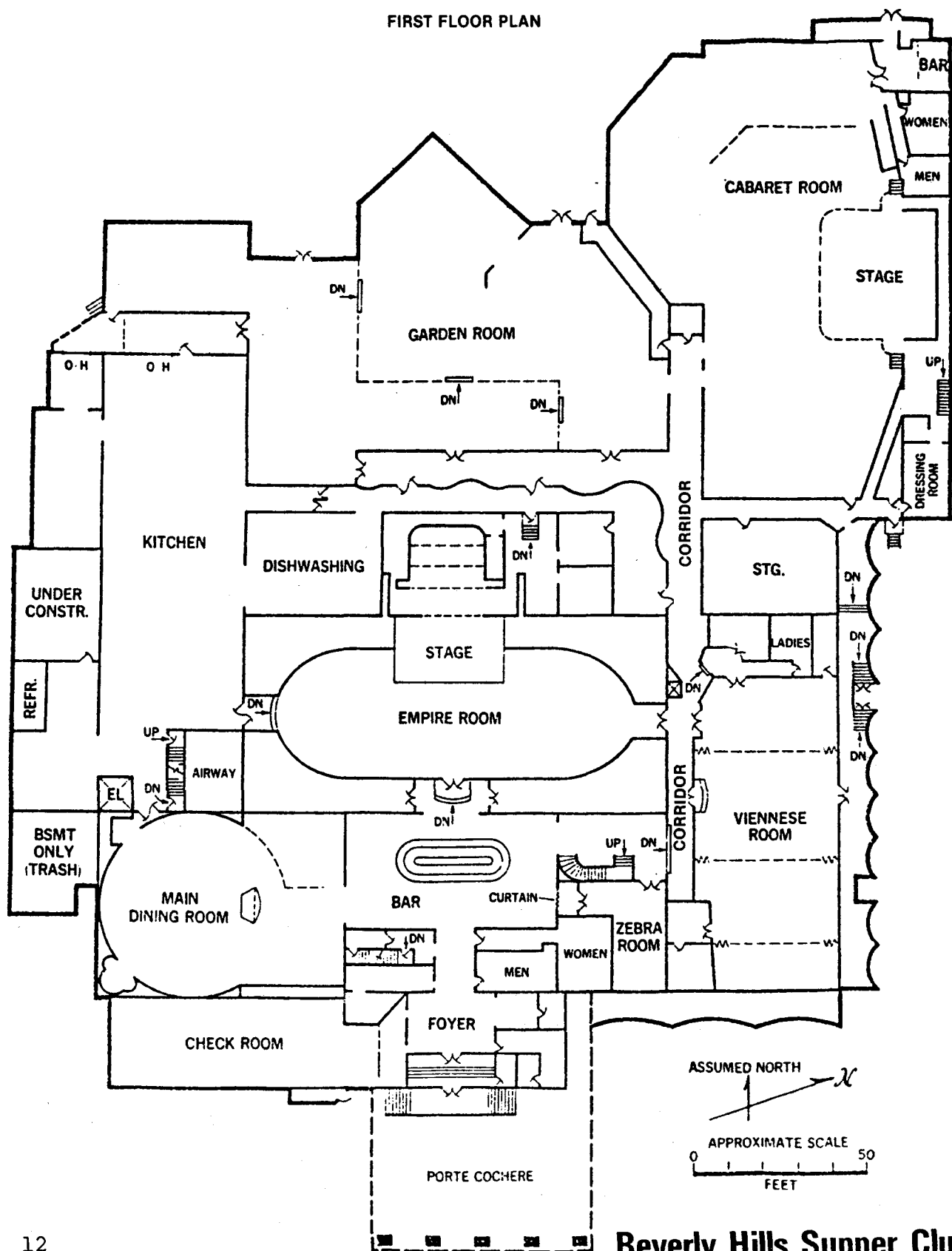
*Alderson, S. and Breden, L., Evaluation of the Fire Performance of Carpet Underlayments, Nat. Bur. of Stds., NBSIR 76-1018, Sept. 1976.

In the writer's opinion, the main contributor to the continued and extensive build up of thermal radiation in the main corridor, sufficient to promote the continued burning of carpet, was probably the combustible wall paneling.

It appears that if the walls of the main corridor had been covered with a noncombustible material, in lieu of the hard-board paneling used, and the same carpet assembly was in place as was actually used, there may not have been a rapid, extensive spread of fire along this corridor.

CONCLUSIONS

1. Once the Zebra Room was fully involved in fire, i.e., flashover had occurred, sufficient thermal energy was available to push the fire out of the north, double doors into the small corridor outside.
2. Sufficient thermal energy was available from the Zebra Room to ignite and sustain a fire in this small corridor on the carpet and plywood wall paneling.
3. The combination of the thermal energy outputs of the Zebra Room and small corridor were of sufficient magnitude to ignite and sustain a fire in the main corridor to the Cabaret Room.
4. Once the fire was established in the main corridor, the fire progressed rapidly towards the Cabaret Room, probably reaching the Cabaret Room some two to five minutes after entering the main corridor.
5. The fire in the main corridor also spread laterally in the small cross corridor behind the south wall of the Cabaret Room.
6. The combination of the fire in the main corridor and in the cross corridor ultimately blocked two of the three exits from the Cabaret Room leaving the remaining occupants with only one exit through the service bar area to the outside.
7. The air conditioning system does not appear to have played any significant role in the spread of fire towards the Cabaret Room.



APPENDIX A - DESCRIPTION OF MATERIAL SAMPLES SUBMITTED TO
NBS BY STATE OF KENTUCKY

State Exhibit 72 and 73

Kentucky Description - Carpet and padding from Zebra Room.

NBS Identification - Carpet is of dense construction consisting of low loops with a cut pile. Outer pile is nylon. Carpet has netting sublayer of olefin and a backing of jute. Pile height is 0.375 inches and weight is 58 oz/yd².

Padding is of waffle design of latex rubber. The pad is backed with thin polyester. Pad weight is 74 oz/yd².

Remarks - No further tests were conducted on these samples, particularly the carpet, as both had been exposed to fire.

State Exhibit 78

Kentucky Description - Sample of acoustical tile from basement storage.

NBS Identification - Aluminum-backed, mineral-type, acoustical tile, 23-3/4" x 23-3/4" x 3/4" thick. White finish, Glacier Shadowline pattern. Manufacturer unknown. Weight was 19 lbs/ft³. Surface pattern resembles acoustical plaster.

Remarks - Location where used in the Club is not known. Subjected to Radiant Panel Flame Spread Test, ASTM E-162. Results in Appendix B.

State Exhibit 79

Kentucky Description - Sample of carpet padding from Cabaret Room.

NBS Identification - Foam rubber underlayment with thin paper backing. Height - 0.25 inches. Weight - 87 oz/yd².

Remarks - No further tests conducted on this sample.

State Exhibit 80

Kentucky Description - Sample of carpet padding taken from storage in basement of same type as used in corridor leading to Cabaret Room.

NBS Identification - Underlayment is of jute with a height of 0.5 inches (uncompressed) and with a weight of 51 oz/yd².

Remarks - This underlayment was used in conjunction with State Exhibit 81 for several tests as a carpet/underlayment assembly. See Appendix B for results of tests.

State Exhibit 81

Kentucky Description - Sample of carpet taken from storage in basement of same type as used in corridor leading to Cabaret Room and same type as used in Cabaret Room.

NBS Identification - Carpet is of tightly woven wool construction with a low, cut pile. The carpet has two sublayers. One is of cotton and the other is of jute. Pile height is 0.25 inches and carpet weight is 78 oz/yd². The carpet has been blended with another fiber believed to be nylon. The nylon appears to constitute less than 10% of the carpet face.

Remarks - Several tests were conducted on this carpet as an assembly using the underlayment identified as State Exhibit 80. This carpet/underlayment assembly represents the actual carpet/underlayment assembly that was present on the floor of the main corridor between the Zebra Room and the Cabaret Room the night of the fire. See Appendix B for results of tests.

State Exhibit 88

Kentucky Description - Two (2) sheets of masonite paneling from storage.

NBS Identification - Hardboard paneling with simulated walnut decorative face. Thickness - 0.25 inches. Weight - 48 lbs/ft³.

Remarks - Location where used in Club, not known. Samples subjected to Radiant Panel Flame Spread Test, ASTM E-162 and to Smoke Density Chamber Test, NFPA-258, See results in Appendix B.

State Exhibit 90

Kentucky Description - Ceiling tile from storage of type believed to have been in corridor to Cabaret Room.

NBS Identification - Mineral-type, fissured surface, acoustical tile. Dimensions - 12" x 12" x 3/4". Designed for kerf and spline (concealed) installation. Approximate weight - 22 lbs/ft³.

Remarks - Specimens were subjected to Radiant Panel Flame Spread Test, ASTM E-162. See Appendix B for results.

APPENDIX B - RESULTS OF TESTS CONDUCTED ON MATERIAL SAMPLES
SUBMITTED TO NBS BY STATE OF KENTUCKY

Radiant Panel Flame Spread Test Results - ASTM E-162

<u>Exhibit No.</u>	<u>Is</u>
78	35
81 & 80	322
88	129
90	19

Remarks: All results are the average of four runs except 78 and 90 which were the average of only two runs each due to sample quantity limitations. The flame spread indices for the mineral tiles (#78 and 90), were as expected as was the flame spread index for the paneling (#88). The flame spread index for the carpet/underlayment assembly (#81 and 80) were about as to be expected considering the thickness of the assembly which was 0.75 inches.

Flooring Radiant Panel Test Results

<u>Exhibit No.</u>	<u>Critical Radiant Flux</u> <u>W/cm²</u>
81 and 80	0.78

Remarks: The critical radiant flux of 0.78 W/cm² is the average of these runs. The performance of the carpet/underlayment was good, relative to other commercially-available carpets. This is to be expected from wool carpets which tend to resist flame spread to a higher degree than carpets of other fibers.

Smoke Density Chamber Test Results - NFPA 258

<u>Exhibit No.</u>	<u>Exposure F or N</u>	<u>Max. Specific Optical Density (Corrected)</u>	<u>Indicated Gas Concentrations in PPM</u>		
			<u>HCl</u>	<u>HCN</u>	<u>CO</u>
81 & 80	F	395	12	31	1000
81 & 80	N	450	-	-	-
88	F	95	0	2	1500
88	N	580	-	-	-

Remarks:

1. F is for flaming exposure, N is for nonflaming exposure.
2. Results are the average of three trials.
3. The toxic gas determinations were conducted on one trial only and were done by taking grab samples with Drager tube colometric indicators.
4. Results were as expected from the types of materials tested. The carpet/underlayment yielded fairly high smoke generation numbers in both the flaming and nonflaming modes. The hardboard paneling gave low numbers flaming and high numbers in nonflaming mode characteristic of a wood-based products. The major toxic gas component was carbon monoxide (CO) again characteristic of these types of materials.



UNITED STATES DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

June 16, 1977

MEMORANDUM FOR Mr. R. Bright

From: Maya Paabo & James Brown

MP JAB

Subject: Analysis of seat components from Kentucky fire

The seat cover and padding samples were analyzed for the basic polymer composition by infrared spectroscopy and for elements indicative of a fire retardant (e.g. Cl, Br, P and Sb) by x-ray fluorescence. The results of the analyses are listed in the attached table.

Of the five samples analyzed none appear to be fire retarded. The seat cover exhibits a high chloride content because of the presence of polyvinyl chloride. The outside back padding contains chlorine only as a minor component. Without a detectable quantity of phosphorus, this is being interpreted that no fire retardants are present.



Sample No.		Polymer ID	Elemental Composition	
			Major	Minor
103-1	Seat cover	PVC*	Cl, Pb	Ca,Cr,Fe,Al,Si
103-2	Padding, inside back	Polyurethane, TDI/polyether type	—	Si,S,Sn
103-3	Padding, outside back	Polyurethane, TDI/polyether type	—	Si,S,Cl,Sn,Ca
103-4a	Padding, seat white layer	Polyurethane, TDI/polyether type	S,Ba	Sr,Sn
103-4b	Padding, seat green layer	Styrene/butadiene rubber	K,Zn	Si,S,Ca,Fe

* Plasticized with 2-ethylhexyl decyl phthalate and filled with calcium carbonate